Providing the ideal environment to maximise laying potential

The industry has seen a large increase in the construction of modern environmentally controlled houses across regions where open sided housing was the norm, especially in the tropical regions of the world. One of the primary reasons for these changes in housing is the need for higher levels of biosecurity, especially in countries with high concentrations of both commercial and domestic poultry and ongoing outbreaks of diseases such as avian influenza.

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The drive for ever higher levels of efficiency and rising labour costs, has seen the broiler breeder housing and equipment industry continue to develop, introducing modern technologies in line with trends in modern management, communication and ventilation systems.

As expected with these developments, early adoption has been in markets such as Europe and North America, with their historically high labour and utility costs, which easily justified investment in and adoption of these modern technologies.

Due to the market volatility experienced by most poultry growers in many of the developing countries financial constraints continue to limit access to improved equipment and housing designs.

With ever increasing numbers of broiler breeders being placed in regions of the world with high summer temperatures, the approach to providing the ideal environment to maximise production should be focused on the nesting, house structure and environmental control systems.

Improving labour utilisation

The adoption of mechanical community nest systems across the industry is being driven by the need to improve labour utilisation and biosecurity, which in turn has led to increases in stocking densities from 4.5 to 5.0-6.5 hens/m^2.

Higher stocking densities means higher house heat loads and pressure on ventilation systems to maintain hen comfort and welfare. These higher stocking densities require more efficient ventilation systems in both the hot and cold seasons.

Furthermore, the mechanical nesting and feeding systems have unique ventilation requirements due to their influence on air movement dynamics.

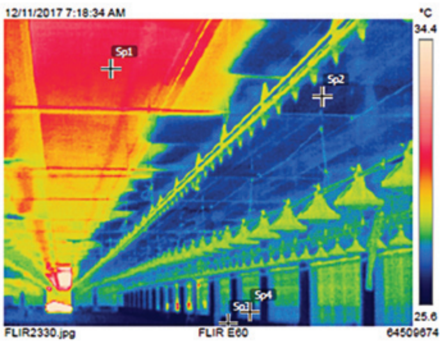
Many new investment decisions are often made without taking into full consideration the high levels of environment control needed to ensure optimum bird performance.

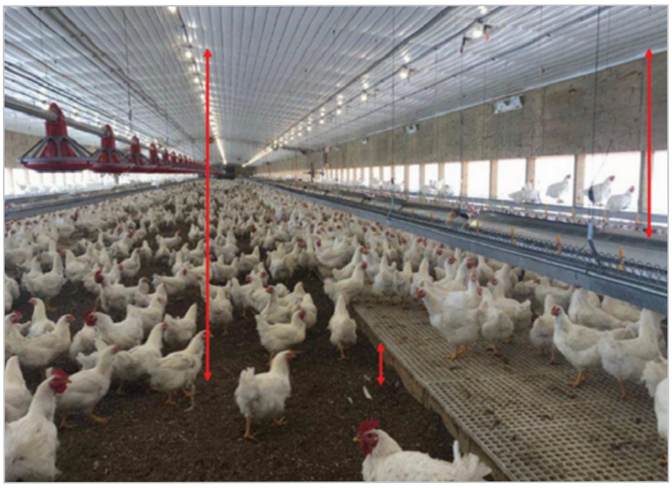
Some common mistakes, especially in tropical countries to reduce investment costs, include:

- Poor or no insulation in either the roof or on top of the drop ceiling.

Fig. 1. Thermal image of a house under construction.

Measurements	
Sp1	30.5°C
Sp2	26.6°C
Sp3	25.6°C
Sp4	27.4°C





Minimise the height difference between the ceiling and the slat scratch areas. The lower the difference the better the airspeed distribution. The lower the pitch on the roof or drop ceiling the better.

The assumption still prevails that in a hot climate insulation is not important and the benefits do not outweigh the high cost.

- Lack of perimeter inlets for minimum and transition ventilation.

- Inadequate static pressure controls due to poor sealing of houses – often through poor roof/ceiling and curtain installations.

Total heat load

The total heat load in any broiler breeder house is a function of how much heat is transferred to the house through the building surfaces, the heat entering via the ventilation system and most importantly the amount of metabolic heat produced by the birds.

Heat flows through surfaces from hot to cold, entering the house through the ceiling, side walls and curtains. The higher the resistance to flow or higher the R value of the surface, the lower the emissivity. As well as entering the house through all surfaces, heat is also produced by the birds which is by far the greatest contributors to heat load in a well-designed and insulated tunnel house.

The roof is probably the single most important aspect of any new broiler breeder house and insulation choice is critical to optimise bird comfort and welfare.

The vast majority of tunnel ventilated broiler breeder houses in most tropical or sub-tropical regions of the world will have a non-insulated drop ceiling, constructed of sheet metal or plastic.

While this design helps to reduce solar heat penetration and affords small amounts in terms of insulation value compared to an uninsulated open truss metal roof, the advantages of insulation cannot be understated.

The thermal image in Fig. 1 is of a house under construction with a plastic drop ceiling installed below the metal roof with some insulation material already in place. The thermal image spot temperatures Sp1 and Sp2 are intended to illustrate the value in terms of surface temperature reduction of the insulated versus non-insulated surfaces: Sp1 (no insulation) 30.5°C compared to Sp2 26.6°C.

These lower surface temperatures indicate significantly improved insulation or heat transfer. During hot days this differential will be even more extreme.

A broiler breeder house in a hot

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environment should have a minimum insulation in the roof of R10-12. It could be argued that improving the roof or drop ceiling R value from a R10 to a R20 will make minimal impact in terms of house heat load in hot weather – but it will have an important impact in terms of heating costs in cold environments, especially during brooding of broiler breeder pullet chicks.

Traditionally, most broiler breeder houses have been constructed with white curtain sidewalls due to unreliable electricity supplies and the fear of backup generator failure, and to provide natural light.

The relatively small initial difference in investment cost between solid insulated side walls versus curtain installations are very easily offset by their advantages.

Key being the tightness or ability to maintain static pressure of a solid side wall when compared with the high maintenance and short life span of a traditional curtain side wall.

The biggest challenge when building poultry houses longer than 100m is maintaining an acceptable temperature pickup from the front to the back of the house, or commonly referred to as the ΔT, during the summer months.

The level of bird comfort plays an important part in daily egg production and laying activity.

As incoming fresh air moves down the length of a broiler breeder house in full tunnel mode, the amount it heats up will depend primarily on two factors:

- The ability and amount of heat transferred from the hens to the air surrounding them. The cooler the air the greater the amount of heat transfer and vice-versa for warmer air.

- How quickly this air is exchanged.

Heat is removed from the house by rapidly exchanging the air in conjunction with evaporative cooling systems. If the temperature difference between the birds and the surrounding air is minimal, heat removal from the birds will be low. By increasing the temperature differential through evaporative cooling and improved insulation, bird heat removal will be increased. The faster the air exchange rate, the cooler a house will be.

An even temperature distribution over the length of the house will ensure comfort, distribution and ultimately the broiler breeders' production and utilisation of the nest boxes. Unfortunately, air exchange alone will not guarantee bird comfort. A minimum air velocity is also needed to provide a level of wind chill for the hens. The design goal of the tunnel ventilation in a hot environment is threefold: house heat removal, bird heat removal and temperature reduction of the incoming air through evaporative cooling.

Broiler breeder tunnel houses are moving away from the traditional 12m × 120m design with either manual nests and full scratch or a two-thirds slat and one-third scratch configuration.

The longer and wider houses are being constructed to better optimise capital investment and hen stocking densities.

The 14m × 150m tunnel house with traditional US style two-thirds slat or community nest are starting to gain traction. All new broiler breeder houses in hot climates are being equipped with tunnel airspeed capabilities of at least 3m/s or 600fpm.

To ensure each hen has exposure to the best environment during hot weather, whether on the slats or in the scratch area, attention needs to be given to the cross-sectional profile of the house. Air will always choose the path of least resistance.

Fig. 2. Manual nest boxes with and without slats. The airspeeds are intended as simple examples only and were measured at about 30m from the tunnel fans at a height of about 1m. Airspeeds vary considerably over a house cross section.

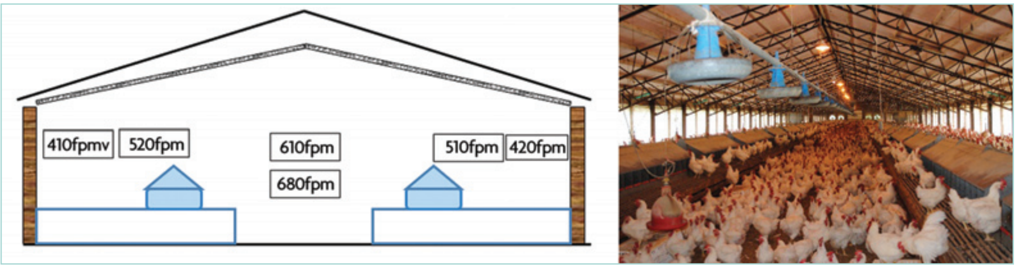


Fig. 3. Mechanical nests.

Fig. 4. Community nests. Configuration with only one chain feeder on the slats. There are three loops of chain feeders or six lines giving a potential density of 6.7 females/m² with 15cm feeder space. Nipples are at 20cm intervals.

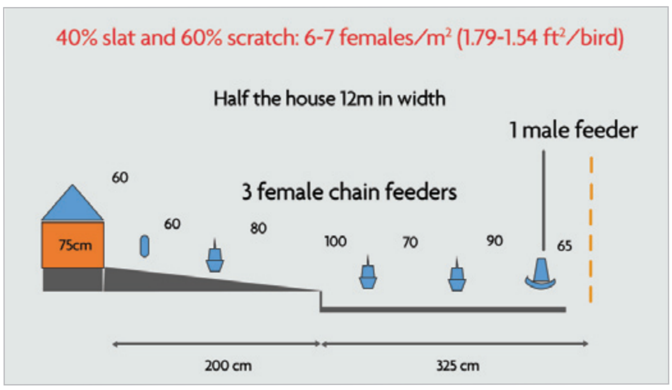
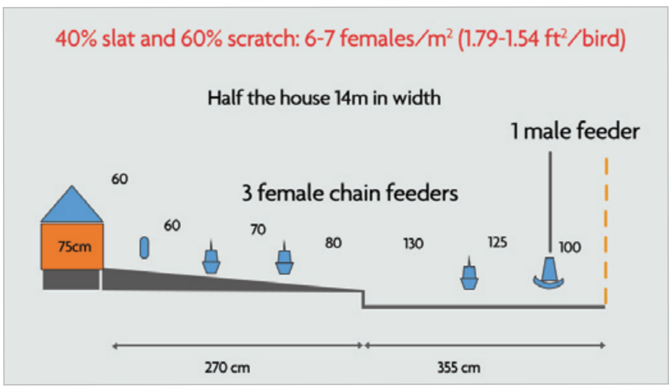


Fig. 5. Community nest. Configuration with only two chain feeders on the slats and one in the scratch area. All chain feeders are placed directly on the slats using low profile grills. The feeder lines in the scratch area are winched with legs and low profile grills.



Some examples include:

- **Manual nest boxes with and without slats:**
The position and orientation of the manual nest boxes will impact the airspeeds measured and ultimately the comfort of the hen during hot weather (Fig. 2).

- **Mechanical nests – US configuration one-third scratch and two-thirds slats:**
Airspeeds and air exchanges on the slats are always lowest with the highest in the scratch area (Fig. 3).

- **Community nests:**
The industry is starting to move towards the adoption of the community nest configuration for better capital utilisation and labour costs. The two configurations of the community nest system shown in Figs. 4 and 5 differ in terms of house width and equipment layout.

Design considerations

When designing new broiler breeder houses, one of the main objectives is to try to reduce the airspeed differences over the house cross section.

The following factors are important considerations:

- What is the difference between slat height and scratch area height?

- The lower the slat height the better.

- The lower the pitch on the roof or drop ceiling the better.

- Always avoid exposed posts on side walls – airspeeds are always slowest against rough side walls. Solid side walls are the easiest way to avoid this problem.

In a broiler breeder house with a US type mechanical nest configuration, as more tunnel fans are turned on, the greatest response

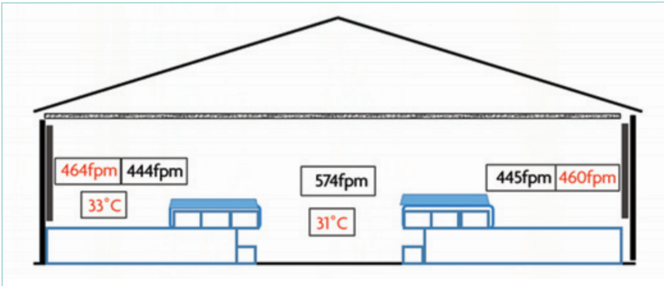


Fig. 6. Differences between the slats and the scratch areas.

in terms of airspeed will always be in the scratch area.

Adding more fan capacity will generally not make significant improvements to the broiler breeders' environment on the slats.

An important management consideration when setting up an environment controller for tunnel ventilation is always to allocate the sensor(s) in the tunnel fan end to control the levels of ventilation.

A common challenge is managing the ΔT, which can be significantly different on the slats compared to the scratch area. This is especially true for older houses with poor or no insulation during very hot and humid conditions, which will typically occur during the afternoons.

Dry bulb temperatures taken on the slats and scratch areas at the tunnel fan end of the house can differ as much as 2-3°C.

The 2°C difference between the slats and scratch areas in Fig. 6 are a function of the differences in air exchanges or airspeeds: 444 (2.26m/s) to 464fpm (2.36m/s) on slats vs 574fpm (2.92m/s) in the scratch area. Lower speeds or exchanges mean less heat is removed from birds on the slats than in the scratch area. In Figs. 7 and 8 are some examples of thermal images of broiler breeders at the front (evaporative cooling end) and back (tunnel fan end) of the same house.

The surface or skin temperatures are considered an indicator of internal temperatures. Under regular environmental conditions skin temperatures of about 38°C would be considered normal.

Conclusion

Designing and managing the environment control system in a broiler breeder house is critical to guarantee optimum laying potential and behaviour.

Poor environment control will lead to higher levels of floor eggs, eggs laid in cooler scratch areas, and subsequent drops in production.

Egg production and fertility numbers are always recorded in terms of the whole house, but if measured in terms of location in the house, productivity will vary. ■

Fig. 7. Hens at the fan end of the house on the slats: Temperature range 40.9-42.6°C.

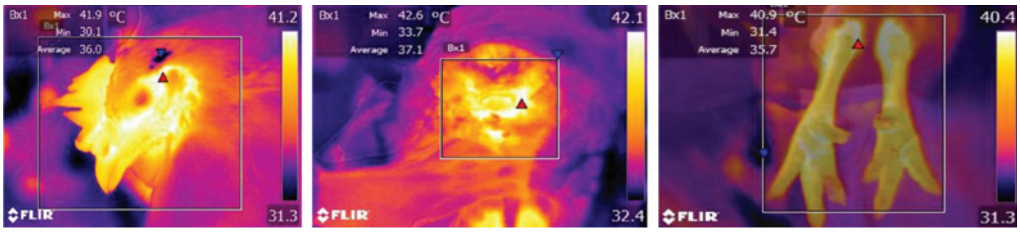


Fig. 8. Hens at the front of the house on the slats: Temperature range: 39.3-40.8°C.